research & development
www.epa.gov/ord
US. EPA, P.O. Box 93478, Las Vegas, NV 89193-3478

October, 2006

Verification of Portable Optical and Thermal Imaging Devices for Leak Detection at Petroleum Refineries and Chemical Plants

Impact Statement

Optical and thermal imaging devices are remote sensing systems that can be used to detect leaking gas compounds such as methane and benzene. Use of these systems can reduce fugitive emission losses through early detection and repair at industrial facilities by providing an efficient and cost effective method for monitoring and inspection of components. This verification study will determine the ability of these systems to provide accurate information to the air quality inspection and monitoring community.

Background

Industrial facilities such as chemical plants and petroleum refineries emit compounds that are listed as toxic or hazardous air pollutants (HAPs). HAPs are of concern because exposure to these classes of compounds has been linked to cancer and other serious health effects. These compounds also react in the atmosphere to form ozone which also has adverse health effects to exposed populations such as facility workers and people living in neighboring communities. Undiscovered gas leaks, known as fugitive emissions, in chemical plants and refinery operations can impact regional air quality and present a loss of product for industry. Identifying existing and potential leaks is a tedious and costly task.

Federal and state fugitive emission monitoring programs are currently based on EPA Method 21. This method involves the use of an organic vapor analyzer to monitor for a leak at each component, such as a valve or flange. The actual number of components to be tested in a refinery or chemical plant can be quite large, making Method 21 monitoring both time intensive and expensive.

The use of remote sensing systems such as optical imagers offers an operator the ability to monitor components from a distance and identify, in some cases instantaneously, leaking components within the line of sight of the optical or thermal imager. The remote sensing and instantaneous detection capabilities of optical and thermal imaging technologies allow an operator to scan areas containing tens to hundreds of potential leaks, thus eliminating the need to visit and manually measure all potential leak sites.

Study Approach

This study will test a number of optical and thermal remote imaging systems to determine their performance for detecting gas compounds. A number of environmental variables can affect the performance of an optical or thermal imaging system used for fugitive leak detection. The type of compound that is leaking, its concentration and leak flow rate, ambient as well as gas temperature, and other variable influence the detection limits and accuracy of these systems. The study will control as many of these variables as possible to determine system performance. A controlled laboratory study will test against chemicals typically found in an industrial facility. Additional field testing will also occur at selected industrial sites.

Status and Next Steps

This project is currently identifying stakeholders who wish to assist in developing the verification methodology. The stakeholders will work with EPA scientists to prepare the verification testing plan and assist with identification of potential vendors. This program is being carried out under EPA's Environmental and Sustainable Technology Evaluation (ESTE)/Environmental Technology Verification (ETV) Program. This is a partial cost-sharing program, and is targeted at addressing high-priority Agency information needs. The program will have high visibility. EPA will initiate and directly manage verifications of up to 10 potential vendors of commercially ready technologies. The verification project will examine several aspects of leak detection performance, including gas compound detection under a variety of environmental conditions, determination of detection limits, measurement accuracy and repeatability, and the portability and usability of these devices. The sensor systems should be able to detect (defined as being able to determine/isolate an object from the background) and visualize the gas leak plume in real-time. Devices that can speciate, or identify the compound, and quantify leaks (i.e. determine mass flux of the leak) will be of special interest. The optical and thermal imagers for leak detection will support the proposed *Alternative Work Practice To Detect Leaks From Equipment* outlined in the Federal Register, April 6, 2006, 40 CFR Part 60, (EPA–HQ–OAR–2003–0199; FRL–8055–2)

Visit www.epa.gov/etv for more information.

Contact

David J. Williams
U.S. Environmental Protection Agency
Office of Research and Development
National Exposure Research Laboratory
Environmental Sciences Division
109 TW Alexander Dr., MS: E243-05
Durham, NC 27711
Phone: 919/541-2573, Fax: 919/685-3039
Email: williams.davidj@epa.gov

The United States Environmental Protection Agency through its Office of Research and Development is funding and managing the research described here. It has been subjected to Agency's administrative review and approved for publication as an EPA document.